Chemistry 1105 R11 Fall 2023 Test 1

Friday, September 29, 2023 Time: 1 hour 50 minutes

Name: ANSWERS Student #: _____

*This test consists of **seven** pages of questions, a page containing the names, symbols, and masses of the elements, and a periodic table. Please ensure that you have a complete test and, if you do not, obtain one from me **immediately**. There are **51** marks available. Good luck!*

1) **[6 marks]** The Capilano water reservoir has the following approximate dimensions:

Width: 300 m
Depth: 87 m
Water volume: 5.79×10^{10} L

a) What is the length of the reservoir? (V = W x D x L) 1 L = 1 dm^3 exactly. Give your answer in km.

$300\ m \times \frac{1\ dm}{1\times10^{-1}\ m} = 3000\ dm$

$87\ m \times \frac{1\ dm}{1\times10^{-1}\ m} = 870\ dm$

$5.79\times10^{10} = 3000 \times 870 \times L$

$\Rightarrow L = 22,184\ dm$

$22,184\ dm \times \frac{0.1\ m}{1\ dm} \times \frac{1\ km}{1\times10^{3}\ m} = \boxed{2.218\ km}$

b) If you use 20 litres of water, how many nm will the water level in the reservoir fall?

$22,184 \times 3000 \times h = 20$

$\Rightarrow h = 3.005\times10^{-7}\ dm$

$3.005\times10^{-7}\ dm \times \frac{0.1\ m}{1\ dm} \times \frac{1\ nm}{1\times10^{-9}\ m} = \boxed{30.05\ nm}$

2) **[4 marks]** A can is filled to the very top with maple syrup (density 1.37 g/cm^3). The can and maple syrup have a combined mass of 1000.0 grams. A rock of mass 87.6 grams is added, causing some of the maple syrup to spill out. The new mass of the can, the maple syrup left in the can, and the rock, is 1073.9 grams. What is the density of the rock? Give your answer in g/cm^3, and **to the correct number of significant figures.**

If no syrup spilled: $1000 + 87.6 = 1087.6$ g

So $1087.6 - 1073.9 = 13.7$ g syrup spilled

$$V_{syrup} = 13.7\,g \times \frac{1\,mL}{1.37\,g} = 10.0\,mL$$

$$= V_{rock}$$

$$D_{rock} = \frac{87.6\,g}{10.0\,mL} = 8.76\,\frac{g}{mL}$$

3) **[2 marks]** An unknown sample (potentially of a compound) had its oxygen content measured. The following data were determined:

Sample mass (g)	mass of oxygen in sample (g)
2.00	0.400
2.10	0.400
2.20	0.400

Is the sample being analyzed a compound? How do you know? (No marks for guessing. 😊)

No. The % O in each sample is not the same.

4) **[3 marks]** If you took 5 grams of S_8 and converted it to SF_4, and 8 grams of S_8 and converted it to S_2F_2, what would be the ratio $\frac{mass\ F\ in\ SF_4}{mass\ F\ in\ S_2F_2}$?

$$\frac{5\ S_8 \times \frac{8S}{1S_8} \times \frac{4F}{1S}}{8\ S_8 \times \frac{8S}{1S_8} \times \frac{2F}{2S}} = \frac{20}{8} = \boxed{\frac{5}{2}}$$

5) **[2 marks]** Classify the following as **He**terogeneous mixtures, **Ho**mogeneous mixtures, **E**lements, or **C**ompounds. Circle your choice.

A cheese sandwich	(He)	Ho	E	C
Table sugar	He	Ho	E	(C)
Oxygen	He	Ho	(E)	C
Coffee with milk	He	(Ho)	E	C

6) **[2 marks]** Pick an element from the periodic table that matches the description given. Only give the symbol of the element (no names necessary)

A group IA non-metal H

A period 3 transition metal Sc (+ others)

A liquid element Br (or Hg)

A solid halogen I

7) **[4 marks total]** Gallium (Ga) has a periodic table mass of 69.723 Da.

a) **[3 marks]** Complete the following table for gallium (Ga):

Nuclide Symbol	mass (Da)	percent abundance
$^{69}_{31}Ga$	68.9256	60.108
$^{71}_{31}Ga$	70.9245	39.892

$100 - 60.108 = 39.892$

$69.723 = 68.9256 \times 0.60108 + M \times 0.39892$

$\Rightarrow M = 70.9245$

b) **[1 mark]** Which isotope of gallium has the greatest number of protons?

Both are the same (31)

8) **[12 marks]** Complete the following table:

Compound Name	Compound Formula
potassium sulphide	K_2S
iron (II) chloride	$FeCl_2$
lead(II) phosphite	$Pb_3(PO_3)_2$
aluminum perchlorate tetrahydrate	$Al(ClO_4)_3 \cdot 4H_2O$
gallium hydroxide	$Ga(OH)_3$
hydrogen iodide	$HI(g)$
sulphurous acid	H_2SO_3
periodic acid	HIO_4
sulphur tetrafluoride	SF_4
disulphur difluoride	S_2F_2

9) **[12 marks]** Each of the following reactions is known to occur. Complete and balance them, giving the phases of all products. You need only give the molecular equation in each case.

a) $\_\_\_\_ Al_2CO_3(s) \xrightarrow{\Delta}$ $Al_2O_3(s) + 3CO_2(g)$

b) $\underline{2}\ SO_2(g) + \_\_\_\_ TiO_2(s) \xrightarrow[\text{pressure}]{\text{high}}$ $Ti(SO_3)_2(s)$

c) $\underline{4}\ Li(s) + \_\_\_\_ O_2(g) \longrightarrow$ $2Li_2O(s)$

d) $\underline{2}\ C_7H_8O(l) + \underline{17}\ O_2(g) \longrightarrow$ $14CO_2(g) + 8H_2O(\ell)$

e) $\underline{2}\ NaBr(aq) + \_\_\_\_ F_2(aq) \longrightarrow$ $2NaF(aq) + Br_2(aq)$

f) $\underline{3}\ Mg(NO_3)_2(aq) + \underline{2}\ Na_3PO_4(aq) \longrightarrow$ $Mg_3(PO_4)_2(s) + 6NaNO_3(aq)$

10) **[4 marks total]** For the following reaction:

$2HCl(aq) + Na_2CO_3(aq) \longrightarrow H_2O(l) + CO_2(g) + 2NaCl(aq)$

a) **[2 marks]** Give the full ionic equation.

$2H^+(aq) + 2Cl^-(aq) + 2Na^+(aq) + CO_3^{2-}(aq)$

$\longrightarrow H_2O(l) + CO_2(g) + 2Na^+(aq) + 2Cl^-(aq)$

b) **[1 mark]** Identify any spectator ions.

Na^+, Cl^-

c) **[1 mark]** Give the net ionic equation.

$2H^+(aq) + CO_3^{2-}(aq) \longrightarrow CO_2(g) + H_2O(l)$